

Applicants: Suemasu et al.
Serial No.: 10/820,272
Filing Date: April 8, 2004
Docket No.: 105-63 DIV/RCE III
Response to Office Action dated June 9, 2010
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IN THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in the application:

1-8. (Cancelled)

9. (Previously Presented) A metal filling method comprising steps of:

forming a non-through hole which extends from a first surface toward an opposite surface of a substrate;

forming an oxide layer on an inner peripheral surface portion of the non-through hole adjacent to the first surface of the substrate, and on a portion of the first surface of the substrate adjacent to the non-through hole, such that only the oxide layer is layered on the substrate;

forming a metal layer on the inner peripheral surface portion of the non-through hole adjacent to the first surface of the substrate, and on the portion of the first surface of the substrate adjacent to the non-through hole, such that the metal layer is directly adhered to the oxide layer;

filling the non-through hole with molten metal by providing the molten metal in a decompression chamber, reducing the pressure into the chamber, immersing the substrate in the molten metal, and then after immersion, pressurizing the chamber so that the molten metal flows into the inside of the non-through hole, and allowing the molten metal to solidify; and

removing part of the substrate such that the solidified metal is exposed through the opposite surface of the substrate.

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10. (Cancelled)

11. (Previously Presented) The metal filling method according to claim 10, wherein the filled metal is solidified by discharging the substrate from the molten metal.

12. (Cancelled)

13. (Previously Presented) The metal filling according to claim 9, wherein part of the substrate is removed by polishing.

14. (Previously Presented) The metal filling method according to claim 9, wherein the solidified metal comprises an external section which protrudes from the first surface of the substrate.

15. (Previously Presented) The metal filling method according to claim 14, wherein the external section comprises a bump.

16. (Currently Amended) A metal filling method comprising steps of:

forming a through hole which extends through a substrate from a first surface toward an opposite surface thereof;

forming an oxide layer on an inner peripheral surface portion of the through hole adjacent to the first surface of the substrate, and on a portion of the first surface of the substrate adjacent to the through hole, such that only the oxide layer is layered on the substrate;

forming a metal layer on the inner peripheral surface portion of the through hole adjacent to the first surface of the substrate, and on the portion of the first surface of the substrate adjacent to the through hole, such that the metal layer is directly adhered to the oxide layer;

closing an opening of the through hole in the opposite surface of the substrate;

filling the through hole with molten metal by providing the molten metal in a decompression chamber, reducing the pressure into the chamber, immersing the substrate in the molten metal, and then after immersion, pressuring the chamber so that the molten metal flows into the inside of the through hole, and allowing the molten metal to solidify; and

opening the closed opening of the through hole such that the solidified metal is exposed through the opening of the through hole.

17. (Cancelled)

18. (Previously Presented) The metal filling method according to claim 17, wherein the filled metal is solidified by discharging the substrate from the molten metal.

19. (Cancelled)

20. (Previously Presented) The metal filling method according to claim 16, wherein the opening of the through hole is closed using a sealing material.

21. (Previously Presented) The metal filling method according to claim 16, wherein the solidified metal comprises an external section which protrudes from the first surface of the substrate.

22. (Previously Presented) The metal filling method according to claim 21, wherein the external section comprises a bump.

23. (New) The metal filling method according to claim 9, wherein in the step of filling the non-through hole with molten metal, the chamber is pressurized by feeding an inert gas.

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24. (New) The metal filling method according to claim 23, wherein the molten metal is solidified in a state where the substrate is in the chamber where the inert gas is fed.

25. (New) The metal filling method according to claim 9, further comprising a step of lifting out the substrate from the molten metal so that the molten metal drops off in areas other than the metal layer where the wettability of the molten metal with respect to the substrate is poor.

26. (New) The metal filling method according to claim 16, wherein in the step of filling the through hole with molten metal, the chamber is pressurized by feeding an inert gas.

27. (New) The metal filling method according to claim 26, wherein the molten metal is solidified in a state where the substrate is in the chamber where the inert gas is fed.

28. (New) The metal filling method according to claim 16, further comprising a step of lifting out the substrate from the molten metal so that the molten metal drops off in areas other than the metal layer where the wettability of the molten metal with respect to the substrate is poor.